

Fear for the future: Eco-anxiety and health implications, a systematic review

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ABSTRACT

Background: Although there is no standard definition for eco-anxiety, most authors define it as people's emotional reaction of concern, worry, anxiety, and fear in view of global Climate Change (CC) threats and concurrent environmental degradation. This systematic review was carried out to critically evaluate the evidence on eco-anxiety related to CC and its health implications in general populations.

Methods: We performed a search for scientific articles in PubMed, Scopus, Embase, Web of Science, and Cochrane Central. Studies were included if they complied with the study objective. Selection of articles and data extraction were carried out independently by 2 reviewers. We used the Axis tool and JBI critical appraisal checklist to assess the quality of the studies.

Results: A final sample of 12 articles was included in this review. The methodological quality of the studies was limited. A wide variety of eco-anxiety definitions was used in the different studies but further research is needed to provide conceptual clarity of the term eco-anxiety. Eco-anxiety was associated with functional impairment, symptoms of depression, anxiety, PTSD, stress and insomnia, lower self-rated mental health, and reluctance to have children. Moreover, habitual worry about global warming was associated with a pro-ecological worldview, a green self-identity and pro-environmental behavior, strongly suggesting a constructive nature. Indeed, pro-environmental behavior in the form of climate activism would buffer the impact of CCA cognitive-emotional impairment on MDD symptoms. However, sometimes engaging in pro-environmental behavior might not be successful in dealing with eco-anxiety, since individuals might perceive that their efforts do not help to mitigate the CC crisis.

Conclusions: Results have to be interpreted with caution since the methodological quality of the studies was limited. However, they do suggest a link between eco-anxiety and negative mental health outcomes, mainly in younger generations, women, and poorer countries in the "Global South". Eco-anxiety may constitute a stressor to mental health, particularly if coping mechanisms are not successfully developed.

1. Introduction

In February 2022, the Intergovernmental Panel on Climate Change (IPCC) indicated that from 2040, and depending on the level of global warming, CC will lead to numerous risks to natural ecosystems and human health globally (Intergovernmental Panel on Climate Change,

2022). There is increasing evidence about the relationship between CC, the probability of extreme weather events, and their impact on health. The impacts of CC on human health are classified into direct (consequences of extreme acute weather events) and indirect (consequences of chronic CC on social, economic, and natural ecosystems). Direct effects, caused by heat waves, floods, storms, droughts, and hurricanes, are

Abbreviations: CC, Climate Change; CCA, Climate Change Anxiety; MDD, Major Depressive Disorder; PRISMA, Preferred Reporting Items for Systematic Review and Meta-analyses.

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increased premature mortality from respiratory and cardiovascular disease, food and water-borne illnesses, and hunger. Indirect effects are changes in the geographical distribution of infectious diseases, lack of food and water quality, food and economic insecurity, involuntary migration, and threats to mental health, among others (Centers for Disease Control and Prevention, 2022). The World Health Organization (WHO) states that between 2030 and 2050 CC will cause 250,000 deaths a year due to malnutrition, malaria, diarrhea, and heat stress (WHO, 2021). The impacts of CC on public health will be more severe in population groups for whom socioeconomic inequalities are deeper and/or the health levels of the population and health structures are more precarious. Important considerations include age and people's direct dependence on nature for at least one of their most basic needs.

Global awareness of the CC crisis is high and there is widespread media coverage of this issue. People aware of current and future threats from CC may feel fear and anxiety about potential negative outcomes for their future and the planet. This has been identified especially in younger generations.

Glenn Albrecht is regarded as one of the pioneers of the study of "psychoterratic" syndromes, which he defined in 2011 as mental health impacts as a result of negative emotions caused by perceived environmental and CC (Albrecht, 2011). One of these concepts is eco-anxiety, which could be categorized as people's reactions of worry and anxiety in view of global CC threats and concurrent environmental degradation.

At the moment, there is no standard definition for eco-anxiety and different terms are used interchangeably in the literature, such as Climate Change anxiety (CCA), CC worry, environmental distress, ecological grief, or ecological stress. As a consequence, different definitions are used, including "a chronic fear of environmental doom" (Clayton et al., 2017), "extreme worry about current and future harm to the environment caused by CC" (Duggal, 2022), "heightened emotional, mental or somatic distress in response to dangerous changes in the climate system" (Climate Psychology Alliance, 2022).

Moreover, definitions of eco-anxiety vary regarding its conceptualization as pathological or non-pathological. For some authors, anxiety related to CC threats may be considered as a normal response. In fact, in some people eco-anxiety can trigger environmentally sustainable behaviors (Pihkala, 2020) and, therefore, it is not necessarily indicative of a clinical diagnosis or pathology. On the other hand, in others, high levels of eco-anxiety may cause a deterioration of their mental health, including subjective distress, rumination, sleep disturbance, somatic disturbance, and hopelessness, which are features of anxiety disorders (O'Brien & Elders, 2021). When eco-anxiety is difficult to control and interferes with a person's daily functioning, it is regarded as clinically significant (Clayton, 2020).

Nonetheless, to date, there is no clear knowledge regarding whether or to what extent eco-anxiety may affect human health, which precise health outcomes eco-anxiety may be related to, or the mechanisms through which eco-anxiety interplays with health outcomes. Our hypothesis posits that eco-anxiety related to CC contributes, through a chronic state of heightened emotional distress, to the development of negative health outcomes.

To the best of our knowledge, no previous systematic review has evaluated the relationship between eco-anxiety and health. The present review was carried out to critically evaluate the evidence on eco-anxiety related to CC and to analyze its health implications.

2. Material and methods

2.1. Design

This is a systematic review of studies investigating eco-anxiety and its health implications. The study protocol was registered with the University of York Centre for Reviews and Dissemination International prospective register of systematic reviews (PROSPERO Record CRD42021286612, <http://www.crd.york.ac.uk/PROSPERO/>). This

systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) statement 2020 (Page et al., 2021).

2.2. Source of data collection

We performed a search for scientific articles from the first available date in the following databases until the end of July 2022: PubMed, Scopus, Embase, Web of Science and Cochrane Central. The final search equation was developed for use in PubMed, and then adapted for the rest of the databases consulted (see [Supplementary Material Appendix A](#)), as follows:

("Eco-anxiety"[Title/Abstract] OR "Ecoanxiety"[Title/Abstract] OR "Climate Change Anxiety"[Title/Abstract] OR "Climate Anxiety"[Title/Abstract] OR "Climate Change Worry"[Title/Abstract] OR "Environmental Worry"[Title/Abstract] OR "Environmental Distress"[Title/Abstract] OR "Ecological Grief"[Title/Abstract] OR "Ecological Stress"[Title/Abstract]). In addition, we also completed the search with an assessment of the bibliographic list of the articles selected, including in the analysis those studies that were identified, but had not been detected in the digital search.

2.3. Selection of articles

Inclusion criteria were studies carried out on the general population that were published in peer-reviewed journals, in English, French, Portuguese, or Spanish and complying with the study objective: to evaluate evidence on eco-anxiety related to CC and its health implications. Exclusion criteria were: studies aimed at examining eco-anxiety related to environmental pollution or direct health consequences of a specific natural disaster (such as hurricanes or floods), or studies aimed at validating an eco-anxiety scale, or studies developing therapeutic strategies for eco-anxiety or assessing psychological defense mechanisms against eco-anxiety, or studies aimed at investigating the phenomenon of solastalgia. The selection of relevant studies, based on title and abstract, was carried out independently by 2 authors (IBV and MCE). Possible discordance was resolved by consulting a third author (MSV) and subsequently consensus was reached among all authors. Duplicates identified through the electronic bibliographic databases were removed. Finally, full articles were retrieved. The interobserver variability was calculated using Cohen's kappa coefficient (K).

2.4. Data extraction

The data extraction was carried out independently by 2 authors (IBV and MCE) and discordance was resolved by consulting a third author (MSV). In this review, the studies were first described in relation to study design, aim, main characteristics of the population, sex and age, inclusion and exclusion criteria, sample size, place of data collection, and method of recording data (Table 1). Table 2 includes information on measurement tools or scales used to measure eco-anxiety and health outcomes, the definitions of eco-anxiety, the statistical analysis, and the main and secondary results. Additionally, Appendix B (Supplementary Material), shows detailed information on scales/tools used in the studies to measure both eco-anxiety and the other health issues. Appendix C describes the limitations, strengths, conclusions, and recommendations given in each study.

2.5. Quality of research

In Table 3A, we show the quality assessment of the quantitative and mixed cross-sectional studies included using the Axis tool (Downes et al., 2016). The Axis tool is a critical appraisal tool designed to evaluate the quality of cross-sectional studies, including study design and reporting quality as well as the risk of bias. It consists of 20 items/questions

Table 1

Main characteristics of the studies included in the review.

Study ref.	Aim	Population	Age (years)	Sex	Inclusion and exclusion criteria	Sample size	Place of data collection	Method of recording data
Patrick et al. (2022)	To understand the impact of CC on mental health (including eco-anxiety, post-traumatic stress disorder and pre-traumatic stress disorder) in the Australian population and identify populations who are most at risk of climate-related mental health burden.	Approximately representative sample of adults in Australian population by age, gender, location, state and area disadvantage	>18 years M = 52.71 SD = 19.96	60% female 40% male	IC: NR EC: NR	5483	Australia (states of Victoria, New South Wales, Queensland and other)	Online survey
Sciberras and Fernando (2022)	To identify different trajectories of CC-related worry among Australian adolescents over time and to examine relationship between trajectories and (a) engagement with news and current affairs, and (b) generalized mental health difficulties.	Adolescents in Australia	10–11, 12–13, 16–17 and 18–19 years	50% male 50% female	IC: Children from sampled postcodes born between March 1999 and February 2000 EC: NR	2244	Sampled postcodes across Australia with the exception of most remote areas.	NR
Schwartz et al. (2022)	To examine associations between Climate Change anxiety (CCA) and clinical measures of distress. To investigate individual and collective climate action as potential moderators of associations between CCA and symptoms of generalized anxiety disorder and major depressive disorder. To explore subjective, individualized experiences and behaviors of participants experiencing CCA.	Undergraduate and graduate university students in USA	18–35 years M = 23.17 SD = 3.87	54 (19%) male 224 (78.9%) female 6 (2.1%) other	IC: Undergraduate and graduate university students, aged 18–35 EC: NR	323	USA	Anonymous cross-sectional web-based survey
Helm et al. (2021)	Study 2. To explore how CC-related concerns affect reproductive attitudes and motivations to remain childfree.	Study 2. Young adults in New Zealand and USA	Study 2. 18–35 years	Study 2. 4 male 17 female 3 other	Study 2. IC: considering CC to play important part in their reproductive decision-making, aged 18–35 EC: NR	Study 2. 24	Study 2. USA (Tucson), New Zealand (Auckland and Christchurch)	Study 2. Audio-recorded, exploratory, semi-structured interviews
Hickman et al. (2021)	To understand the feelings, thoughts, and functional impacts associated with CC among young people globally.	Young people living in 10 countries selected	49% aged 16–20 51% aged 21–25 M = 20.82 SD = 2.54	51.4% male 48.6% female	IC: aged 16–25 and living in 1 of 10 countries selected. EC: NR	10,000	10 countries*	International online survey
Ogunbode et al. (2021)	To determine how negative climate-related emotions relate to mental health across a broad range of national contexts, extending beyond Western countries.	Study 1. Individuals from 25 countries Study 2. Residents in Norway	Study 1. M = 23.4 SD = 7.3. Study 2. M = 46.3 SD = 17.5	Study 1. 33.7% male; 63.4% female. Study 2. 47.7% male; 52.3% female	IC:NR EC: NR	Study 1. 10,143. Study 2. 1015	Study 1. 25 countries ** Study 2. Norway	Cross-sectional questionnaire survey
Reyes et al. (2021)	To determine association between CCA and mental health and if CCA can predict mental health.	Filipino belonging to Generation Z***	18–26 years M = 20.4 SD = 1.60	145 male 288 female	IC: Filipino participants belonging to Generation Z aged 18–26. EC: NR	433	Philippines	Online research questionnaire

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Table 1 (continued)

Study ref.	Aim	Population	Age (years)	Sex	Inclusion and exclusion criteria	Sample size	Place of data collection	Method of recording data
Stanley et al. (2021)	To examine how negative eco-emotions uniquely contribute to individuals' wellbeing and engagement with CC solutions.	Individuals living in Australia, nationally representative on age, gender, and location	M = 44.08 SD = 17.46 Median 41.0	44.2% male 55.5% female 0.3% other	IC: believing CC is happening, and humans are largely causing it EC: unsure or denied CC is happening or human-caused	NR	Every state of Australia	Online survey
Verplanken et al. (2020)	Study 1. To establish to what extent habitual worry about global warming is related to chronic pathological worry. Study 2. Replication of Study 1 conducted during COVID-19 crisis, providing test of robustness of Study 1; also tested whether global warming worry was affected by COVID-19 context. Study 3. To establish whether habitual worry about global warming is a form of constructive thinking.	The majority of participants were students from UK, USA or elsewhere.	Study 1. M = 26 SD = 10 Study 2. M = 27 SD = 13 Study 3. M = 26 SD = 11	Study 1. 66 male; 94 female; 6 other Study 2. 76 male; 214 female; 3 other; Study 3. 93 male; 208 female; 5 other;	IC: NR EC: not finalizing the survey or raising suspicions of sloppy or careless responding.	Study 1. 266 Study 2. 293 Study 3. 306	USA, UK, elsewhere	Online survey
Schneider-Mayerson and Leong (2020)	To offer insight into the concerns, considerations, and expectations that are influencing young people that are factoring CC into their reproductive choices.	Young people of child-bearing age from USA	27–45 years	22% male 73% female 5% other	IC: considering CC in their reproductive choices and aged ≥ 27 EC: aged ≥ 45	607	USA	Quantitative and qualitative, exploratory online survey
Berry and Peel (2015)	To contribute evidence on whether CC attitudes and, particularly, worry about CC are linked to mental health and well-being, taking account place-based and sociodemographic factors.	Rural and urban participants from Australia	15–65 years M = 52.48 SD = 14.45	2799 (41.94%) male; 3705 (55.51%) female; 170 (2.55%) other	IC: NR EC: NR	6674	Australia (Rural and regional areas)	Regional Wellbeing Survey (wave 1)
Searle & Gow. (2010)	To investigate the role of personality characteristics and vulnerability factors in predicting CC distress within the general population.	University students and members of the general public from AUS (Brisbane, State of Queensland)	≥ 18 . 57% aged 18–25	39% male; 61% female	IC: University students and members of the general public who were 18 years of age and above EC: NR	275	Australia (Brisbane, State of Queensland)	Cross-sectional questionnaire survey

CC=Climate Change; CCA=Climate Change anxiety; EC = exclusion criteria; GAD = generalized anxiety disorder; IC = inclusion criteria; MDD = major depressive disorder; NR = non-referred; Ref. = reference; UK=United Kingdom; USA=United States of America, *Australia, Brazil, Finland, France, India, Philippines, Portugal, Nigeria, United Kingdom, USA, **Australia, Brazil, Canada, Chile, China, Finland, Germany, Italy, Indonesia, Iran, Japan, Malaysia, Netherlands, Nigeria, Norway, Pakistan, Philippines, Portugal, Romania, Russia, Slovakia, Spain, Tanzania, Uganda, United Kingdom, ***Generation Z: individuals born between 1994 and 2010 (Schawbel, 2016).

distributed in 5 domains/dimensions (Introduction, Methods, Results, Discussion, and Others) with 3 possible answer categories: “Yes”, “No” or “Non-reported or Non-applicable” (Table 3). As the Axis tool does not provide a quality score, we assigned numerical values for each item, with 2 possible values, 0 or 1, and added them up to obtain the total quality score which was classified as: “Good quality” if the majority ($\geq 70\%$) of the items were answered as “Yes”; “Medium quality” if 70%–50% quality items were answered as “Yes”, and “Poor quality” if $\geq 50\%$ of quality item were answered as “No” or “Non-reported” or if $< 50\%$ were answered as “Yes”.

In Tables 3B and 3C we show the quality assessment of the qualitative cross-sectional studies and cohort studies included applying JBI critical appraisal checklist. The purpose of this appraisal is to assess the methodological quality of a study and to determine the extent to which a study has addressed the possibility of bias in its design, conduct and analysis (Lockwood et al., 2020).

The quality evaluation of the studies was carried out independently by 2 authors (MSV and MPV), and discrepancies solved by consulting with a third author (IBV).

3. Results

Using the search criteria described, 843 references were identified (224 PubMed, 10 Scopus, 46 Embase, 562 Web of Science, 1 Cochrane), of which 89 duplicates were removed. On evaluating the abstract and title, 701 articles were eliminated. We retrieved and analyzed a sample of 53 full-text articles and rejected 46. Five articles were included through manual search, leaving a final sample of 12 articles included in this review (Fig. 1).

The studies included were Patrick et al. (Patrick et al., 2022), Schwartz et al. (Schwartz et al., 2022), Sciberras et al. (Sciberras & Fernando, 2022), Helm et al. (Helm et al., 2021), Hickman et al.

Table 2
Eco-anxiety measurements and health implications.

Study reference	Measurement tools/Scales	Validation	Eco-anxiety definition	Health endpoints	Covariables	Statistical analysis	Main results	Secondary results
Patrick et al. (2022)	Online survey measured: <i>Eco-anxiety</i> : CCA Scale (Clayton & Karazsia, 2020) <i>Post-traumatic stress disorder (PTSD)</i> : PTSD-8 scal (Mollica, 2004) <i>e Pre-traumatic stress</i> : amended PTSD-8 scale	CCA Scale (Clayton & Karazsia, 2020) PTSD (Mollica et al., 1992)	Eco-anxiety referred to CCA: cognitive-emotional and functional impairment related to perceptions of CC	PTSD, pre-traumatic stress	Gender, age and postcode. Whether they had direct experience of CC-related event/s (eg. bushfire, flood and heat waves)	Multivariable regression to examine eco-anxiety and PTSD after adjusting for age, state, location, and IRSD	Participants who had direct experience with CC had higher odds for eco-anxiety. All younger age groups had significantly higher odds for eco-anxiety; greatest being youngest group (18–34 years). Participants residing in more disadvantaged areas had higher odds for eco-anxiety. Of the participants who reported experiencing CC directly, approximately 25% met the screening for criteria for PTSD.	Females had no significant differences compared with males for eco-anxiety; regional areas showed no significant differences compared with major cities. Among participants who had not experienced a CC event, nearly 16% met the screening criteria for pretrauma Stress. Pretrauma symptoms were more common among females and younger adults
Schwartz et al. (2022)	Web-based survey measured: CCA: CCA Scale (Clayton & Karazsia, 2020) <i>Individual climate action</i> : 5-item scale (Clayton & Karazsia, 2020) <i>Climate activism</i> : adapted version of Environmental Actions Scale (Alisat & Riemer, 2015) <i>Major depression disorder (MDD) symptoms</i> : 8-item Patient Health Questionnaire (PHQ-8; Kroenke et al., 2009) <i>Generalized anxiety disorder (GAD) symptoms</i> : GAD-7 Scale (Spitzer et al., 2006) <i>Climate change (CC) experience</i> : 3-item scale (Clayton & Karazsia, 2020) Optional open-ended questions about addressing/worry about CC	CCA Scale, Individual Climate Action Scale, CC Experience Scale (Clayton & Karazsia, 2020) Environmental Actions Scale (Alisat & Riemer, 2015) PHQ-8 (Kroenke et al., 2009) GAD-7 (Löwe et al., 2008)	Eco-anxiety referred to CCA: negative cognitive-emotional and functional impairment related to perceptions of CC	Major depressive disorder (MDD) symptoms and generalized anxiety disorder (GAD) symptoms,	Age, gender, race, financial aid recipient, 1st-generation college student, USA born, student status; individual climate action, climate activism, extent to which individuals have experienced CC impacts	To examine CCA subscales, individual action and climate activism as predictors of MDD and GAD: 2 multi-variable linear regression models Qualitative analysis of optional open-ended questions: exploratory, inductive approach	Higher CCA functional impairment was significantly associated with higher MDD symptoms. Higher levels of both CCA cognitive-emotional impairment and CCA functional impairment were significantly associated with higher GAD symptoms.	Climate activism buffered impact of CCA cognitive-emotional impairment on MDD symptoms. Higher individual action was associated with lower MDD and GAD symptoms. Responses describing CC worries illustrated 4 major themes: environmental damage, collective inaction, human global suffering, individual suffering.
Sciberras and Fernando (2022)	<i>CC-related worry</i> : one question regarding how worried/concerned they were about CC <i>Mental health</i> : Kessler 10 (K10) depression scale (Kessler et al., 2003) <i>Engagement with politics, news and current affairs</i> . 3 questions	K10 (Pereira et al., 2019)	Eco-anxiety referred to: worry and concern about CC	Depression symptoms	Country of birth, whether they were Aboriginal or Torres Strait Islander, caregiver's sex, level of education and sex. Engagement with politics, news and current affairs.	Latent profile analyses determined trajectories of CC worry ^a at age 10–11, 12–13, 16–17 and 18–19. Linear regression analyses examined association between CC worry trajectories and outcomes at 18–19 years.	The high persistent worry group had higher depression symptoms compared to those with moderate worry. Adolescents with increasing cc-related worry did not have higher depressive symptoms at 18–19 years. However,	Adolescents with high persistent and increasing worry had higher engagement with politics and news compared to adolescents with moderate worry.

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Table 2 (continued)

Study reference	Measurement tools/Scales	Validation	Eco-anxiety definition	Health endpoints	Covariables	Statistical analysis	Main results	Secondary results
							adolescents characterized by high persistent or slightly decreasing worry did have slightly higher levels of depression symptoms than those with moderate worry. The increasing, low persistent and steep decreasing worry groups did not differ from moderate worry group in depression symptoms.	
Helm et al. Study 2 (2021)	Semi-structured interviews (ad hoc) on how concern for CC affects reproductive attitudes	Non-referred (NR)	Eco-anxiety referred to: CC-related concerns	Increased reluctance to have children derived from CC- related concerns	Age, gender identity, country, race/ethnicity	Thematic analysis was used to analyze transcripts through NVivo 12 and hand-drawn mind maps	Most participants expressed serious concern for future and battled with CCA. Individuals are choosing to go childfree due to 3 CC-related reasons: overconsumption, overpopulation, an uncertain future. All participants mentioned not having children as the biggest positive choice one can make for the environment.	Tension between decision to go childfree and: -social norms and pressures -individual actions might not have impact, especially due to continued systemic failures. -belief that younger generations would be more climate aware, which set up hope.
Helm et al. (2021)								
Hickman et al. (2021)	Online questionnaire survey (ad hoc) on emotional/cognitive/ functional experiences related to CC and government response	NR	Eco-anxiety referred to climate anxiety: climate-related worry and emotions (feeling sad, helpless, anxious, afraid, optimistic, angry, guilty, ashamed, hurt, depressed, despair, grieved, powerless, indifferent)	Functional impacts (feelings about CC negatively affecting eating, concentrating, work, school, sleeping, spending time in nature, playing, having fun, relationships)	Age, gender, country; climate-related thoughts, experience of being ignored/dismissed when talking about CC, beliefs about government response to CC, emotional impact of government response to CC	To explore whether climate-related distress, functioning, and negative beliefs about CC were linked to thoughts/feelings about government response: Pearson's correlation analysis	60% "very" or "extremely" worried about CC. A range of negative beliefs reported, 75% saying the future was frightening. >50% reported negative emotions in relation to CC. >45% said feelings about CC negatively affected daily lives. Among those who talked with others about CC, 48% reported having been ignored/ dismissed.	Countries expressing more worry and greater functioning impact tended to be poorer, more directly impacted by CC, in Global South; Portugal highest worry level in Global North. Among same level of CC worry, those who reported feeling betrayed by government response reported increased number of negative thoughts.
Ogunbode et al. (2021)	Two questionnaire surveys measured: <i>Negative climate-related emotions</i> : 7- item index based on state anxiety component of the State-Trait Anxiety Inventory (Spielberger et al., 1983) <i>Insomnia symptoms</i> : Bergen Insomnia Scale (Pallesen	Bergen Insomnia Scale (Pallesen et al., 2008)	Eco-anxiety referred to: negative climate-related emotions (feeling tense, anxious, worried, and terrified)	Insomnia symptoms and self-rated mental health	Age, gender, country	To assess relationships between climate-related emotions, insomnia, and mental health: correlation analysis, linear multilevel regression and weighted least squares regression	Negative climate-related emotions positively predicted insomnia symptoms and negatively predicted mental health in cross- national sample (Study 1) and in Norwegian sample (Study 2)	Study 1. Insomnia symptoms inversely related to age, positively with gender (female). Significantly, older respondents reported better mental health and females worse. Study 2. Age negatively related to

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Table 2 (continued)

Study reference	Measurement tools/Scales	Validation	Eco-anxiety definition	Health endpoints	Covariables	Statistical analysis	Main results	Secondary results
Stanley et al. (2021)	et al., 2008) <i>Self-rated mental health</i> : Single-item scale from Mental Health Ontario Health Survey (Ahmad et al., 2014) Online survey measured: <i>Mental health outcomes (depression, anxiety, and stress)</i> : DASS-21 (Lovibond & Lovibond, 1995) <i>Eco-emotion measures (eco-anxiety, eco-depression and eco-anger)</i> : 6-item scale (ad hoc.) <i>Pro-climate behaviours</i> : 16-item scale (ad hoc.)	DASS-21 (Henry & Crawford, 2005)	Eco-emotion measures: eco-anxiety (anxious, afraid), eco-depression (depressed, miserable), and eco-anger (angry, frustrated)	Depression, anxiety, and stress Personal and collective pro-climate behaviours	NR	Correlations to show relation of eco-emotions to mental health outcomes. Confirmatory factor analysis to assess dimensionality of eco-emotions and behavior. Structural equation modelling R to examine unique relationships between eco-emotions and experiences of depression, anxiety, and stress; and between eco-emotions and pro-climate behavior	Eco-anxiety relates to greater anxiety and stress in daily lives. Eco-depression, to greater depression, anxiety and stress. Eco-anger relates to lower anxiety, depression, and stress. Eco-anger is only significant predictor of personal behavior. Eco-anger and eco-depression relate to greater collective action, and eco-anxiety, to lower.	insomnia symptoms, positively to mental health. Gender (female) significantly related to insomnia symptoms.
Reyes et al. (2021)	A questionnaire measured: CCA: CCA Scale (Clayton & Karazsia, 2020) <i>Psychological distress and well-being</i> : Mental Health Inventory (MHI-38; Veit & Ware, 1983)	CCA Scale (Clayton & Karazsia, 2020) MHI-38 (Santos & Novo, 2020)	Eco-anxiety referred to CCA: negative cognitive-emotional and functional impairment related to perceptions of CC	Psychological distress (anxiety, depression, loss of behavioral/emotional control) and well-being (emotional ties, positive affect, life satisfaction)	Age, gender, severe calamities experienced (such as tropical storms, floods, and heatwaves)	To assess relationship between CCA Scale and Mental Health Inventory: Pearson's correlation and linear regression analysis	Increase in CCA is associated with significant decrease in overall mental health. CCA is associated with higher psychological distress.13.5% of the MHI variance could be explained by CCA level.	NR
Verplanken et al. (2020)	3 online surveys measured: Study 1. <i>Trait pathological worry</i> : 16-item Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) <i>Habitual worry concerning global warming, personal issues, and world economy</i> : listing 10 worrying thoughts followed by Habit Index of Negative Thinking (HINT; Verplanken et al., 2007). Study 2. Identical to Study 1, except "worry about world economy" replaced by "about coronavirus" Study 3. <i>Habitual worrying about global warming</i> : identical to Study 1 <i>Pro-ecological worldview</i> :15-item New Ecological Paradigm Scale (NEP; Dunlap et al., 2000)	PSWQ (Meyer et al., 1990) HINT (Verplanken et al., 2020) NEP (Reyna et al., 2017) PANAS (DePaoli & Sweeney, 2000)	Studies 1, 2, 3. Eco-anxiety referred to: Habitual worrying thoughts about global warming	Study 1 and 2. Trait pathological worry. Study 3. Determinants of pro-environmental behavior (pro-ecological worldview, pro-environmental values, past pro-environmental behavior, green self-identity) and emotions when thinking of global warming, (determined, anxious, angry)	Studies 1, 2, 3. Age, sex, country of residence, (non) student Study 1. Habitual worry about personal issues and world economy. Study 2. Habitual worry about personal issues and coronavirus Study 3. Perceptions of global warming as psychologically proximal or distal	Study 1. Bivariate correlations between trait pathological worry and habitual worry measures. Study 2. Bivariate correlations for trait pathological worry and habitual worry measures. To investigate whether global warming worry was influenced by COVID-19 context: chi-square test. Study 3. Bivariate correlations between global warming worry and: perceptions of global warming, determinants of environmentalism, and global warming -associated emotions. To identify constructs uniquely account for variance in global warming worry: multiple regression analysis	Study 1 and 2. Medium-size correlations present between trait pathological worry and habitual worry about global warming. When controlled for the other 2 sources of worry, correlation between pathological worry and global warming worry dropped to a non-significant partial correlation. Study 3. Global warming worry was associated with the perception of global warming both as distant and proximal threat, anxiety, positive emotions, and determinants of pro-environmental behavior, thus strongly suggesting a constructive nature.	Study 1. Age correlated significantly negatively with trait pathological worry; women scored statistically significantly higher. Study 2. Age correlated significantly negatively with trait pathological worry; women scored statistically significantly higher, and also on global warming worry. Measures of global warming worry were unaffected by COVID-19 context. Study 3. Women scored higher on pro-ecological worldview, behavior, values, and anxious emotions. Age correlated positively with pro-ecological

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Table 2 (continued)

Study reference	Measurement tools/Scales	Validation	Eco-anxiety definition	Health endpoints	Covariables	Statistical analysis	Main results	Secondary results
Schneider - Mayerson et al. (2020)	<i>Emotions:</i> Positive and Negative Affect Schedule (Watson et al., 1988). <i>Pro-environmental values, green self-identity, psychological distance, past pro-environmental behavior:</i> 5 scales (ad hoc) An exploratory quantitative and qualitative survey (ad hoc) about how young people are factoring CC in their reproductive choices	NR	Eco-anxiety referred to: CC concerns	Reproductive plans affected by CC-related concerns	Age, gender, sexual orientation, country, origin, race, income, education level, political views, religiosity	To assess association between CC-related concerns, and age, gender, bachelor's/doctoral degree or without: ordered logistic regression. To assess relationship between concerns about carbon footprint of procreation and concerns about climate impacts: bivariate regression, Spearman's Rank test	59.8% and 96.5% were "very or extremely concerned" about carbon footprint of procreation and climate impacts on children, respectively. Anxiety, hopelessness, and despair about children in a climate-changed future was so strong that 6.3% of parents confessed to feeling some regret about having children	worldview, weakly positively with past pro-environmental behavior and green self-identity. Of 400 responses that offered likely vision future, 92.3% were negative. Many argued that viewing CC through lens of individual choice was an ineffective framing of a collective problem.
Berry et al. (2015)	Data from wave 1 of Regional Wellbeing Survey measured: <i>Mental health problems:</i> Kessler 10-item Psychological Distress Scale (Kessler et al., 2003) <i>Emotional well-being:</i> Scale NR 3 items measuring: <i>Belief in human-induced CC, worry about CC, distrust of science</i>	K10 (Pereira et al., 2019)	Eco-anxiety referred to: worry about CC	Mental health (symptoms of anxiety and depression) and well-being (life satisfaction, happiness, and optimism)	Age, sex, education, income, residency; belief in human-induced CC; distrust of science	To explore relationships among correlates and predictors of both "worry" about CC and trust in climate science: hierarchical linear regression	They found no evidence to suggest that general community worry about CC is substantially linked to population-level psychiatric morbidity. More distressed, pessimistic, less satisfied people tended to worry about CC slightly more.	Tended to worry slightly more: residents of capital cities, women, younger, more educated, with high incomes. Tended very slightly to disagree with CC items: farmers, living on rural properties, older, working long hours, homeowners, more optimistic, satisfied, and happier people.
Searle et al. (2010)	A questionnaire survey measured: <i>CC distress:</i> 12-item CC distress scale (ad hoc)	NEP (Reyna et al., 2017)	Eco-anxiety referred to CC distress: CCA (feeling concerned)	Symptoms indicative of clinical levels of depression	Age, gender, beliefs about human-environment	Hierarchical regression analyses to identify important predictors and determine extent to which environmental beliefs,	Small association between CC distress and depression, anxiety, and stress. Moderate association between CC	Females showed significantly greater levels of CC distress and CCA. Younger age had highest mean rating of CC distress.
Searle et al. (2010)	<i>Environmental beliefs:</i> New Ecological Paradigm scale (NEP; Dunlap et al., 2000) <i>Depression, anxiety, and stress:</i> Short version of DASS-21 (Lovibond & Lovibond, 1995) <i>Future anxiety:</i> Future Anxiety Scale (Zaleski et al., 2019) <i>Intolerance of uncertainty:</i> The short version of the Intolerance of Uncertainty	DASS-21 (Henry & Crawford, 2005) FAS3 (Zaleski et al., 2019) IUS-12 (Wilson et al., 2020) SCSRFQ-SF (Dianni et al., 2014)	tense, worried, anxious, depressed, stressed, angry, scared, sad about CC) and CC hopelessness (feeling hopeless, powerless, helpless about CC)	, anxiety, and stress.	interactions, future anxiety, intolerance of uncertainty, religiosity	future anxiety, intolerance of uncertainty and religiosity accounted for variability in CC outcomes	distress and environmental beliefs and future anxiety.	Significant difference in age groups ratings of CC distress and CCA. Pro-environmental beliefs and future anxiety were strongest predictors of CC outcomes.

(continued on next page)

Table 2 (continued)

Study reference	Measurement tools/Scales	Validation	Eco-anxiety definition	Health endpoints	Covariables	Statistical analysis	Main results	Secondary results
	Scale (IUS-12; Carleton et al., 2007) Religiosity: Santa Clara Strength of Religious Faith Questionnaire – short form (SCSRFQ-SF; Plante et al., 2000)							
CCA=Climate Change anxiety; CC=Climate Change; GAD = generalized anxiety disorder; IRSD= Internal Revenue Service Document; MDD = major depressive disorder; NR = non-referred; PTSD= Post-traumatic stress disorder; USA= United States of America. a Six patterns of worry were identified (Moderate worry, High persistent worry, Increasing worry, Low persistent worry, Slightly decreasing worry, Steep decreasing worry).								

(Hickman et al., 2021), Ogunbode et al. (Ogunbode et al., 2021), Reyes et al. (Reyes et al., 2021), Stanley et al. (Stanley et al., 2021), Verplanken et al. (Verplanken et al., 2020), Schneider-Mayerson and Leong (Schneider-Mayerson & Leong, 2020), Berry and Peel (Berry & Peel, 2015) and Searle and Gow (Searle & Gow, 2010). The quality evaluation of the studies was carried by 2 authors and discordance solved by consulting a third with high interobserver agreement, kappa coefficient >80%. The topicality of the articles was calculated using the Burton–Kebler semi-period, which showed that the references had a median age of 1 year, and the Price Index, which showed that 83.3% of documents were under 5 years old.

The main characteristics of the studies included in our review are shown in Table 1. All studies were published between 2010 and 2022 and complied with the research question. All studies had a cross-sectional design, except (Sciberras & Fernando, 2022), which had a longitudinal design. All studies were conducted in the general population, in 3 the sample was composed only or mainly of students (Schwartz et al., 2022; Searle & Gow, 2010; Verplanken et al., 2020), and in one mainly of rural population (Berry & Peel, 2015). Mean age of participants ranged from 20.4 to 27.0 years old in 5 studies (Hickman et al., 2021; Ogunbode et al., 2021; Reyes et al., 2021; Schwartz et al., 2022; Verplanken et al., 2020) and from 44.1 to 52.7 in four studies (Berry & Peel, 2015; Ogunbode et al., 2021; Patrick et al., 2022; Stanley et al., 2021). All studies, except two (Hickman et al., 2021; Sciberras & Fernando, 2022), included more female participants than male. Nine studies (Helm et al., 2021; Hickman et al., 2021; Reyes et al., 2021; Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022; Sciberras & Fernando, 2022; Searle & Gow, 2010; Stanley et al., 2021; Verplanken et al., 2020) defined inclusion and/or exclusion criteria. Sample sizes ranged from 24 participants (Helm et al., 2021) to 11,158 subjects (Ogunbode et al., 2021). Eight studies were conducted in only one country: USA (Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022), Australia (Berry & Peel, 2015; Patrick et al., 2022; Sciberras & Fernando, 2022; Searle & Gow, 2010; Stanley et al., 2021), and the Philippines (Reyes et al., 2021) and 4 were conducted using a cross-national sample (Helm et al., 2021; Hickman et al., 2021; Ogunbode et al., 2021; Verplanken et al., 2020); the biggest number of countries included in one study was 25 countries (Ogunbode et al., 2021). All studies used surveys as the tool to collect data, except one (Helm et al., 2021) which used audio-recorded semi-structured interviews. One study used qualitative methodology (Helm et al., 2021) and 2 used a mixed-method approach (Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022).

All studies examined were cross-sectional, except Sciberras and Fernando (2022), which was longitudinal, and used data from the Kindergarten (K) cohort of the population-based Longitudinal Study of Australian Children (LSAC).

3.1. Definition of eco-anxiety

There was a wide range of eco-anxiety definitions used in the different studies (Table 2). Thus, most of the studies measured eco-anxiety as different emotions in response to CC, such as: feeling anxious (Hickman et al., 2021; Ogunbode et al., 2021; Searle & Gow, 2010; Stanley et al., 2021), feeling or being worried (Berry & Peel, 2015; Hickman et al., 2021; Ogunbode et al., 2021; Sciberras & Fernando, 2022; Searle & Gow, 2010), feeling tense (Ogunbode et al., 2021; Searle & Gow, 2010), helpless, powerless, sad, depressed, angry (Hickman et al., 2021; Searle & Gow, 2010), grieved, guilty, (Hickman et al., 2021), afraid (Hickman et al., 2021; Stanley et al., 2021) and terrified (Ogunbode et al., 2021). Having habitual worrying thoughts about CC was measured in one study (Verplanken et al., 2020). In 3 studies (Patrick et al., 2022; Reyes et al., 2021; Schwartz et al., 2022), eco-anxiety was measured as functional impairment (interference of concern about CC with a person's ability to work or socialize) and as cognitive-emotional impairment (rumination, difficulty sleeping or

Table 3A

The assessment of the quality of the studies included in the systematic review applying the Axis tool for quantitative and mixed cross-sectional studies.

Study (year)	Introduction	Methods										Results					Discussion		Other		Total score		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19*	20	Y	N	NR
Patrick et al. (2022)	1	1	1	0	0	0	0	1	1	1	1	1	NR	0	NR	1	1	1	0	NR	55%	30%	15%
Schwartz et al. (2022)	1	1	0	0	0	0	0	1	1	1	1	1	NR	0	NR	1	1	1	NR	NR	50%	30%	20%
Hickman et al. (2021)	1	1	0	0	0	0	0	1	0	1	1	1	NR	0	NR	1	1	1	1	NR	50%	35%	15%
Ogunbode et al. (2021)	1	1	0	0	0	0	0	1	1	1	1	0	NR	0	NR	1	1	1	1	1	55%	40%	5%
Stanley et al. (2021)	1	1	0	0	0	0	0	1	1	1	1	1	NR	0	NR	1	1	0	1	1	55%	10%	35%
Reyes et al. (2021)	1	1	0	1	1	0	0	1	1	1	1	1	NR	0	NR	1	1	1	1	1	70%	20%	10%
Verplanken (2020)	1	1	0	0	0	0	0	1	1	1	1	1	NR	0	NR	1	0	1	1	1	55%	35%	10%
Schneider-Mayerson et al. (2020)	1	1	0	0	0	0	0	1	NR	0	1	1	NR	0	NR	1	1	1	NR	NR	40%	35%	25%
Berry et al. (2015)	1	1	0	0	0	0	0	1	NR	0	0	0	NR	0	NR	1	0	1	NR	NR	25%	50%	25%
Searle et al. (2010)	1	1	0	0	0	0	0	1	0	1	1	1	NR	0	1	1	1	1	NR	1	55%	35%	10%

Y=Yes; N=No; NR=Non-reported; NA=Non-applicable. *If the answer to question 19 is "No", the score for this question erroneously underestimates the total score due to the way the question is formulated, which is why we will take it into account in the finally score as a "Yes".

List of questions.

Introduction.

1. Were the aims/objectives of the study clear?.

Methods.

2. Was the study design appropriate for the stated aim(s)?.

3. Was the sample size justified?.

4. Was the target/reference population clearly defined? (Is it clear who the research was about?).

5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?.

6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?.

7. Were measures undertaken to address and categorize non-responders?.

8. Were the risk factor and outcome variables measured appropriate to the aims of the study?.

9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialed, piloted, or published previously?.

10. Is it clear what was used to determine statistical significance and/or precision estimates? (e.g., p values, CIs).

11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?.

Results.

12. Were the basic data adequately described?.

13. Does the response rate raise concerns about non-response bias?.

14. If appropriate, was information about non-responders described?.

15. Were the results internally consistent?.

16. Were the results for the analyses described in the methods, presented?.

Discussion.

17. Were the authors' discussions and conclusions justified by the results?.

18. Were the limitations of the study discussed?.

Other.

19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?.

20. Was ethical approval or consent of participants obtained?.

Table 3B

The assessment of the quality of the studies included in the systematic review applying JBI critical appraisal checklist for qualitative cross-sectional studies.

Study (year)	Questions (10)	Answers				Total score			
		Y	N	U	NA	Y	N	U	NA
Helm et al. (2021)	1. Is there congruity between the stated philosophical perspective and the research methodology?	X				80%	0%	20%	0%
	2. Is there congruity between the research methodology and the research question or objectives?	X							
	3. Is there congruity between the research methodology and the methods used to collect data?	X							
	4. Is there congruity between the research methodology and the representation and analysis of data?	X							
	5. Is there congruity between the research methodology and the interpretation of results?	X							
	6. Is there a statement locating the researcher culturally or theoretically?	X							
	7. Is the influence of the researcher on the research, and vice-versa, addressed?			X					
	8. Are participants, and their voices, adequately represented?	X							
	9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?			X					
	10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	X							

Y=Yes; N=No; U=Unclear; NA=Non-applicable.

Table 3C

The assessment of the quality of the studies included in the systematic review applying JBI critical appraisal checklist for cohort studies.

Study (year)	Questions (11)	Answers				Total score			
		Y	N	U	NA	Y	N	U	NA
Sciberras and Fernando (2022)	1. Were the two groups similar and recruited from the same population?	X				72.7%	18.2%	9.1%	0%
	2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	X							
	3. Was the exposure measured in a valid and reliable way?	X							
	4. Were confounding factors identified?		X						
	5. Were strategies to deal with confounding factors stated?		X						
	6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?			X					
	7. Were the outcomes measured in a valid and reliable way?	X							
	8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	X							
	9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	X							
	10. Were strategies to address follow up utilized?	X							
	11. Was appropriate statistical analysis used?	X							

Y=Yes; N=No; U=Unclear; NA=Non-applicable.

concentrating, and nightmares or crying because of CC).

3.2. Tools to measure eco-anxiety

Seven studies (Ogunbode et al., 2021; Patrick et al., 2022; Reyes et al., 2021; Schwartz et al., 2022; Searle & Gow, 2010; Verplanken et al., 2020) used scales to measure eco-anxiety, but only 3 (Patrick et al., 2022; Reyes et al., 2021; Schwartz et al., 2022) used a specifically designed scale to measure anxiety due to CC: the Climate Change Anxiety Scale (CCAS; Clayton & Karazsia, 2020). Other scales used to measure eco-anxiety were: a 7-item index based on the State-Trait Anxiety Inventory (Ogunbode et al., 2021), the Habit Index of Negative Thinking (Verplanken et al., 2020), a Climate Change distress scale (ad hoc) (Searle & Gow, 2010), 6-item eco-emotion scale (ad hoc.) (Stanley et al., 2021). Two studies (Hickman et al., 2021; Schneider-Mayerson & Leong, 2020) developed questionnaires (ad hoc), one study (Stanley et al., 2021) measured eco-anxiety with two items, two (Berry & Peel, 2015; Sciberras & Fernando, 2022) measured eco-anxiety with only one item, and another (Helm et al., 2021) conducted semi-structured interviews (Appendix B).

It should be noted that only 4 of the 12 studies (Patrick et al., 2022; Reyes et al., 2021; Schwartz et al., 2022; Verplanken et al., 2020) included scales/questionnaires which were validated: Clayton & Karazsia, 2020 (Clayton & Karazsia, 2020), Verplanken et al., 2007 (Verplanken et al., 2007).

3.3. Main health endpoints under study

We observed high variability around health-related problems studied

in relation to eco-anxiety. Symptoms of anxiety and depression were measured in 4 studies (Berry & Peel, 2015; Reyes et al., 2021; Schwartz et al., 2022; Searle & Gow, 2010; Stanley et al., 2021); only depression in one (Sciberras & Fernando, 2022). In one, anxiety, depression, and loss of behavioral/emotional control were categorized as psychological distress (Reyes et al., 2021). Symptoms of stress (Searle & Gow, 2010; Stanley et al., 2021), insomnia (Ogunbode et al., 2021) and pathological worry (Verplanken et al., 2020) were also measured as negative health outcomes. Negative functional impacts related to feelings about CC were measured in one study (Hickman et al., 2021). PTSD was studied in one (Patrick et al., 2022). Two studies investigated reproductive plans affected by CC-related concerns (Helm et al., 2021; Schneider-Mayerson & Leong, 2020).

On the other hand, positive psychological well-being was measured in 2 studies in terms of life satisfaction (Berry & Peel, 2015; Reyes et al., 2021), emotional ties, positive affect (Reyes et al., 2021), happiness and optimism (Berry & Peel, 2015). One study (Ogunbode et al., 2021) measured self-rated mental health, in which higher rates indicate better mental health. In two studies, a constructive impact of eco-anxiety was assessed in the context of determinants of pro-environmental behavior (Verplanken et al., 2020) and personal and collective pro-climate behaviours (Stanley et al., 2021).

3.4. Covariables

Other variables under study were: severe calamities experienced (such as tropical storms, floods, and heatwaves) (Reyes et al., 2021), direct experience of CC-related event/s (Patrick et al., 2022) the extent to which individuals have experienced the impacts of CC, individual

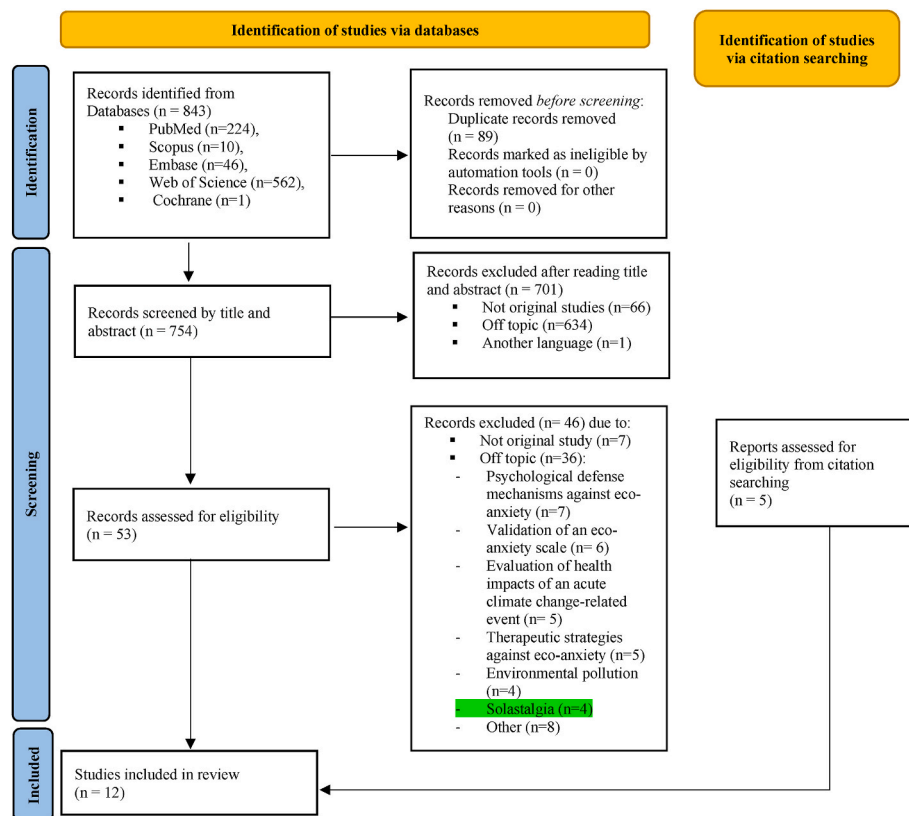


Fig. 1. Flow chart outlining study selection.

climate action and climate activism (Schwartz et al., 2022), environmental beliefs (Searle & Gow, 2010), belief in human-induced CC and distrust of science (Berry & Peel, 2015), beliefs about and emotional impact of government response to CC (Hickman et al., 2021), and perceptions of global warming as psychologically proximal or distal determinants of psychological disorders (Verplanken et al., 2020), engagement with politics, news and current affairs (Patrick et al., 2022).

3.5.1. Main results

Eight of the 12 studies included (Hickman et al., 2021; Ogunbode et al., 2021; Reyes et al., 2021; Schwartz et al., 2022; Sciberras & Fernando, 2022; Searle & Gow, 2010; Stanley et al., 2021) observed associations between eco-anxiety and different health problems. Eco-anxiety was associated with symptoms of depression (Schwartz et al., 2022; Sciberras & Fernando, 2022; Searle & Gow, 2010), anxiety (Schwartz et al., 2022; Searle & Gow, 2010; Stanley et al., 2021), stress (Searle & Gow, 2010; Stanley et al., 2021) insomnia (Ogunbode et al., 2021), higher psychological distress (Reyes et al., 2021) lower self-rated mental health (Ogunbode et al., 2021), and PTSD (Patrick et al., 2022). Furthermore, in one study (Hickman et al., 2021), more than 45% of participants showed functional impairment in at least one of the following: eating, concentrating, work, school, sleeping, spending time in nature, playing, having fun and relationships, associated to negative feelings about CC. The longitudinal study (Sciberras & Fernando, 2022) found that adolescents with high persistent worry had higher depression symptoms compared to those with moderate worry. On the other hand, eco-anxiety was associated with determinants of pro-environmental behavior (Verplanken et al., 2020). A pro-environmental behavior (climate activism) was observed to buffer the impact of cognitive-emotional impairment from eco-anxiety on major depressive disorder (MDD) symptoms (Schwartz et al., 2022). In one study (Stanley et al., 2021), eco-anxiety was related to lower collective action.

Moreover, 2 studies (Helm et al., 2021; Schneider-Mayerson &

Leong, 2020) found that participants showing symptoms of eco-anxiety were reluctant to have children because of the climate-related impacts that children would experience in their future, and because they would be contributing to CC through an increase in the carbon footprint.

3.5.2. Secondary results of the studies included

Younger participants (Berry & Peel, 2015; Patrick et al., 2022; Searle & Gow, 2010) and women (Berry & Peel, 2015; Searle & Gow, 2010; Verplanken et al., 2020) reported higher levels of eco-anxiety. In one study (Patrick et al., 2022), females had no significant differences compared with males for eco-anxiety. In one study, participants residing in more disadvantaged areas and those who had direct experience with CC had higher odds for eco-anxiety (Patrick et al., 2022). Another study (Hickman et al., 2021) reported differences between countries: countries expressing more worry about CC and a greater impact on functioning were poorer, in “the Global South”, and more directly impacted by CC; in the “the Global North”, Portugal (which has suffered an increase in wildfires since 2017) showed the highest level of worry. Finally, one study (Berry & Peel, 2015) found no association between eco-anxiety and psychological well-being and psychiatric morbidity (measured as symptoms of anxiety and depression). In another study (Verplanken et al., 2020), the correlation between pathological worry and global warming worry was non-significant after controlling for concerns due to other causes. One study (Sciberras & Fernando, 2022) found that adolescents with high persistent and increasing worry had higher engagement with politics and news compared to adolescents with moderate worry.

3.6. Quality assessment

3.6.1. Quantitative and mixed cross-sectional studies

Seven of the cross-sectional studies included in the present review (Helm et al., 2021; Hickman et al., 2021; Reyes et al., 2021;

Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022; Searle & Gow, 2010; Stanley et al., 2021; Verplanken et al., 2020). Reported their inclusion and exclusion criteria. None of the studies described non-responders or justified the sample size. Most of the studies (Hickman et al., 2021; Ogunbode et al., 2021; Patrick et al., 2022; Reyes et al., 2021; Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022; Searle & Gow, 2010; Stanley et al., 2021; Verplanken et al., 2020) used statistical methods sufficiently described to be reproducible. None of the studies reported information about internal validation, apart from one (Searle & Gow, 2010). All studies discussed their limitations, except for one (Stanley et al., 2021). Only 5 declared no conflict of interest (Hickman et al., 2021; Ogunbode et al., 2021; Reyes et al., 2021; Stanley et al., 2021; Verplanken et al., 2020), conflicts of interest in one (Patrick et al., 2022) and non-reported in the rest (Berry & Peel, 2015; Helm et al., 2021; Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022; Searle & Gow, 2010).

3.6.2. Longitudinal study

The methodological quality of the longitudinal study, (Sciberras & Fernando, 2022), was evaluated separately. The exposure and outcomes were both measured in a reliable and valid way. The follow-up period and the statistical analysis used were appropriate. However, neither confounding factors nor strategies to deal with them were identified.

3.6.3. Qualitative cross-sectional study

The qualitative study (Helm et al., 2021), was also evaluated separately. There was congruity between the research methodology and the research objective of this study. The study also presented congruity between the research methodology the data analysis and the interpretation of results. The participants were adequately represented.

A global rating was given to each study: three studies (Helm et al., 2021; Reyes et al., 2021; Sciberras & Fernando, 2022) were classified as having good quality (70%–80% of quality items answered as “Yes”), 7 studies (Hickman et al., 2021; Ogunbode et al., 2021; Patrick et al., 2022; Schwartz et al., 2022; Searle & Gow, 2010; Stanley et al., 2021; Verplanken et al., 2020) as medium quality (50%–55% of quality items answered as “Yes”) and 2 (Berry & Peel, 2015; Helm et al., 2021; Schneider-Mayerson & Leong, 2020) as poor quality (25%–40% of quality items answered as “Yes”).

4. Discussion

The results of this systematic review showed that eco-anxiety related to CC was associated with depression, anxiety, stress, insomnia, lower self-referred mental health, and functional impairment. Furthermore, eco-anxiety contributed to increased reluctance to have children in climate-concerned populations. On the other hand, eco-anxiety was associated with pro-environmental behavior. Thus, climate activism decreased the impact of eco-anxiety on MDD symptoms. Although there is increasing research interest on this topic, 83.3% of the studies were less than 5 years old (Price index), the overall quality of the studies examined was limited.

4.1. Definition of eco-anxiety

The results of this review show that the lack of a standardized definition of eco-anxiety has led to a high variability of eco-anxiety definitions and measurement tools used. Moreover, sometimes eco-anxiety was defined as one (Berry & Peel, 2015; Sciberras & Fernando, 2022) or two (Stanley et al., 2021) emotions, at other times it was defined as deriving from various emotions (Hickman et al., 2021; Ogunbode et al., 2021; Searle & Gow, 2010). Constructing the definition of eco-anxiety based on a variety of emotions makes it difficult to evaluate the differential impact each emotion may have on the outcomes under study and might lead to overlooking the effect of potential confounding factors (Stanley et al., 2021). Eco-anxiety has also been defined as having

habitual worrying thoughts (Verplanken et al., 2020), or functional or cognitive-emotional impairment (Reyes et al., 2021; Schwartz et al., 2022).

In a recent scoping review, different definitions and terms used for eco-anxiety are discussed. They describe a range of different emotions used to define eco-anxiety that overlap or that might refer to different levels of eco-anxiety such as anxiety, dread, grief, worry, fear and despair. Furthermore, different terms are used in the literature for eco-anxiety such as CC distress, CC or ecological anxiety (Coffey et al., 2021). These terms have been used interchangeably in the literature to refer to eco-anxiety; however, depending on the different emotions included in the eco-anxiety concept they might or might not be comparable because certain definitions may also introduce tautological reasoning with respect to health outcomes.

4.2. Eco-anxiety and associated health problems

Eight of the 12 studies included (Hickman et al., 2021; Ogunbode et al., 2021; Reyes et al., 2021; Schwartz et al., 2022; Sciberras & Fernando, 2022; Searle & Gow, 2010; Stanley et al., 2021) found that higher eco-anxiety was associated to different health problems: symptoms of depression (Schwartz et al., 2022; Sciberras & Fernando, 2022; Searle & Gow, 2010), anxiety (Schwartz et al., 2022; Searle & Gow, 2010; Stanley et al., 2021), stress (Searle & Gow, 2010; Stanley et al., 2021), insomnia (Ogunbode et al., 2021), higher psychological distress (Reyes et al., 2021), lower self-rated mental health (Ogunbode et al., 2021), and PTSD (Patrick et al., 2022). Anxiety that arises from the awareness of global climate threats may have a role in the genesis and chronification of clinical levels of depressive and anxious symptoms, meaning that eco-anxiety may adversely impact mental health (Searle & Gow, 2010). However, the results in this systematic review have to be interpreted with caution since all studies included were cross-sectional studies, except for one, and, therefore, the direction of causal links between eco-anxiety and any of these health outcomes cannot be established. Moreover, none of the studies in this review evaluated underlying mental health problems as a potential explanation for the lower mental health outcome associated to eco-anxiety, except for one study (Verplanken et al., 2020), that measured pathological worry independent of eco-anxiety. Thus, negative emotions about CC could constitute a manifestation of a previous mental health problem. For example, individuals with an anxiety disorder may view global climate threats from a more anxious predisposition (Searle & Gow, 2010). In a similar vein, in one study (Hickman et al., 2021), 45% of the participants surveyed, 10,000 people aged 16–25 from 10 countries, reported that their feelings about CC negatively affected their daily lives in at least one of the following aspects: eating, concentrating, work, school, sleeping, spending time in nature, playing and having fun. However, given that mental health was not assessed independently from eco-anxiety, a clear association between eco-anxiety and functional impairment was difficult to establish.

4.2.1. Findings from the longitudinal study

The results from the longitudinal study of Sciberras and Fernando (2022) show that most Australian adolescents experienced some worry related to CC from early to late adolescence, and that adolescents with persistent and increasing climate worry have greater societal engagement. Furthermore, adolescents with persistent climate worry had higher depressive symptoms compared to those with moderate worry. However, they also found that those who had slightly decreasing worry (unweighted analyses only) did have slightly higher levels of depression symptoms. It is possible that adolescents with slightly decreasing worry may be dealing with climate worries through avoidance or alternatively, it is possible that other worries may be displacing climate worries in this group.

4.3. Adaptive response: pro-environmental behavior

It has been reported that eco-anxiety can imply positive aspects in terms of a more ecologically sustainable lifestyle (Pihkala, 2020). In the present review, 3 studies (Schwartz et al., 2022; Stanley et al., 2021; Verplanken et al., 2020) evaluated eco-anxiety and pro-environmental behavior. Thus, one study (Verplanken et al., 2020) showed that habitual ecological worry, lacking in any psychopathology, was associated with a pro-ecological worldview, a green self-identity and pro-environmental behavior and with a personality structure characterized by openness, strongly suggesting a constructive nature. Moreover, as seen in one of the studies included (Schwartz et al., 2022), a pro-environmental behavior in the form of climate activism would buffer the impact of CCA cognitive-emotional impairment on MDD symptoms. Problem-solving responses are conscious attempts to alter or mitigate the effects of a stressful event and they are frequently viewed as a set of behaviors aimed at resolving the problem that causes the unwanted emotions. Problem-focused coping is a phenomenon to indirectly regulate emotions by focusing on the problem and trying to do something about it. (Lazarus & Folkman, 1984). Thus, climate activism, may provoke a feeling of accomplishment/fulfilment, implying an adaptive regulation of negative emotions and diminishing the impact of CCA cognitive-emotional impairment on the occurrence of symptoms of MDD (Schwartz et al., 2022). However, at the same time, individual actions may be dwarfed by the complex solutions to the climatic crisis, i. e., engaging in pro-environmental behavior might not be successful in dealing with eco-anxiety since individuals might perceive that their efforts do not help to mitigate the CC crisis. Frustration and hopelessness might rise because of this. These aspects were observed in 2 studies in our systematic review (Helm et al., 2021; Schneider-Mayerson & Leong, 2020): there were conflicting beliefs regarding individuals' responsibility since some participants argued that CC is mainly due to an unsustainable "system" (referring to politicians and corporations) and individual actions may not lead to substantial improvement. Moreover, emotional response to government inaction was captured in one study included in our systematic review (Hickman et al., 2021), which found that among people feeling the same level of worry about CC, those who reported feeling betrayed by the governmental response reported an increased number of negative thoughts.

Interesting findings are provided by the study by Stanley et al., 2021, which measured eco-anger and eco-depression as well as eco-anxiety, showing that eco-anger and eco-depression related to greater engagement in collective action, while eco-anxiety predicted lower collective action, or disengagement from the pro-climate movement. These findings, contradictory to previous studies, might be due to different impacts of eco-anxiety in different populations; thus, eco-anxiety can result in a proactive mindset or, conversely, it can – due to being coped with unsuccessfully – turn to inaction or eco-paralysis. The authors of this study (Stanley et al., 2021) discussed that the effect of greater pro-environmental behavior attributed to eco-anxiety could be caused by other unconsidered eco-emotions. This goes in line with the recommendation that each eco-emotion should be measured separately, holding the effects of other eco-emotions constant (Stanley et al., 2021).

4.4. Eco-anxiety and reproductive plans

Eco-anxiety was associated to reluctance to have children in 2 studies (Helm et al., 2021; Schneider-Mayerson & Leong, 2020). In a sample composed of climate-concerned participants, all commented that not having children was the biggest positive choice individuals can make for the environment (Helm et al., 2021). Having fewer or no children because of climate-related concerns can be seen as a manifestation of eco-anxiety: participants expressed a serious concern, anxiety, and even anguish about the climate impacts that children would have to face during their lives (Helm et al., 2021; Schneider-Mayerson & Leong, 2020). It can also be seen as an adaptive response via actions to

mitigate the climate crisis, through decreasing the potential carbon footprint of having children (Helm et al., 2021; Schneider-Mayerson & Leong, 2020).

4.5. Vulnerable groups

Younger participants (Berry & Peel, 2015; Patrick et al., 2022; Searle & Gow, 2010) reported higher levels of eco-anxiety, supporting findings from surveys (Feldman et al., 2010) that found that young people reported either comparable or in some cases higher levels of interest and concern about CC than older age groups. Children are and will be growing up in a world where they will have to face the problems of CC unless we are able to mitigate its impacts, and it is more likely that they will be more directly affected than older people, quoting a 16-year-old: "I think it's different for young people. For us the destruction of the planet is personal" (Hickman et al., 2021). Also, they are more likely to accept the scientific consensus on human causes of CC than adults (Corner et al., 2015). Furthermore, female respondents (Berry & Peel, 2015; Searle & Gow, 2010; Verplanken et al., 2020) reported higher levels of eco-anxiety. This is consistent with previous research suggesting that females are more worried than males about CC. Sundblad et al. (Sundblad et al., 2007) investigated cognitive and affective risk judgements and found that even though men and women did not differ in their predictions of the probability of serious negative consequences occurring as a result of CC, women were more worried about the consequences. Thus, it was expected that women would possess greater levels of CC distress than men. In another study, Doherty et al. (Doherty & Clayton, 2011) found that women suffered more stress and anxiety and were more behaviorally engaged, with higher rates of PTSD following a disaster, than men. Geographical differences in frequency of eco-anxiety were also observed. Poorer countries from "the Global South", expressed more concern about CC and a greater impact on everyday life than richer countries (Hickman et al., 2021). This may be due to differences in terms of population vulnerability to CC and adaptation capacities (Intergovernmental Panel on Climate Change, 2022). In "the Global North", Portugal, which has suffered an increase in wildfires since 2017, showed the highest level of worry (Hickman et al., 2021).

Thus, there is a need to support groups that are more vulnerable to climate change, such as those with pre-existing health conditions, and those with limited resources and whose lives, survival, health and development chances, are threatened by climate change. A nationwide Australian survey which examined levels of direct experience of climate change events identified populations most at risk of climate-related mental health burden. The majority of respondents reported having direct experience of a climate change-related event. Those from more disadvantaged regions were more affected by eco-anxiety, and women were more affected by pre- and post-traumatic stress (Patrick et al., 2022).

4.6. Limitations of the studies included in the review

The results of this systematic review have to be interpreted with caution due to different aspects which have to be considered. As shown in Table 3, the methodological quality of most of the studies was limited, with only one study, Reyes et al. (2021), classified as having good quality. All studies evaluated had a cross-sectional design which does not allow conclusions to be drawn about the causal nature of the association between eco-anxiety and health outcomes. Cross-sectional studies are prone to reverse causality because temporal ordering of exposure and outcome cannot be established, making impossible to establish the independent contribution of eco-anxiety. Thus, only one (Verplanken et al., 2020) of the 12 studies measured levels of mental health disorders independently from eco-anxiety; i.e., high levels of a maladaptive response to CC may be a consequence of previous anxiety or depressive disorder. The diversity of the associations observed between eco-anxiety and health problems might reflect the lack of a

standardized definition and methodology to measure eco-anxiety which may have led to classification bias. Additionally, the different definitions that were used made comparisons between studies difficult. Most of the studies designed specific questions to ask about eco-anxiety in an effort to reduce the possible recall bias. We cannot rule out completely that selection bias might have occurred.

On the one hand, it is likely that those who were more concerned or worried about CC were most likely to participate and answer the on-line surveys, which was the most frequent mode of data collection in 9/12 studies (Berry & Peel, 2015; Hickman et al., 2021; Ogunbode et al., 2021; Patrick et al., 2022; Reyes et al., 2021; Schneider-Mayerson & Leong, 2020; Schwartz et al., 2022; Stanley et al., 2021; Verplanken et al., 2020). On the other hand, it is also likely that those from vulnerable groups - poorer, younger, rural populations and those more exposed to extreme weather events - were less likely to have access to the internet and to answer an on-line survey. People exposed to a direct acute CC event have been observed as having more intense negative emotions toward CC.

4.7. Limitations of this systematic review

The heterogeneity of the studies did not allow for a meta-analysis. When the search equation was applied, a large number of articles that were not ultimately relevant to the study objective emerged. This may have been due to the wide search equation used because currently different terms are used to refer to eco-anxiety and to the lack of specific descriptors (MeSH), which meant that we used Title and Abstract fields to search in PubMed. We searched in PubMed, Scopus, Embase, Web of Science and Cochrane Central and, therefore, we believe that, if there was a risk of publication bias from missing other key databases, this was minimal.

4.8. Strengths of this systematic review

To the best of our knowledge, this is the first systematic review about this increasingly relevant public health issue as reflected for the Burton-Kebler and the Price Indexes. The strengths of this review are the rigorous use of standard tools of proven methodological quality to evaluate the studies, and the independent selection and review of the articles including their quality, with high concordance among researchers. We also searched for articles written in 4 languages (English, French, Portuguese, and Spanish). We attempted to minimize bias in the review by adhering to a registered protocol and following the PRISMA statement (Page et al., 2021).

5. Conclusions and recommendations

Our results have to be interpreted with caution since the methodological quality of the studies was limited, most studies were cross-sectional and the sample size of the systematic review was small. Data suggests a relation between eco-anxiety and symptoms of depression, anxiety, stress, insomnia, cognitive-emotional and functional impairment, and reluctance to have children, mainly, in younger generations, women, and poorer countries. On the other hand, these results suggest that eco-anxiety may be associated to pro-environmental behavior, which could buffer its negative health impacts.

Research is needed to characterize this global public health issue. Considering the marked heterogeneity of eco-anxiety definitions used in the literature, it is clear that the establishment of a common definition is urgently needed. There is a need to measure each eco-emotion separately, although this may not be an easy task because we still do not know the exact mechanisms that are involved when it comes to CC concerns and related health implications.

It is reasonable to think that eco-anxiety may constitute a stressor to mental health, particularly if coping mechanisms are not successfully developed. Maybe teachers, parents and peers could provide support for

people with eco-anxiety in order to engage them in the adoption of adaptative coping strategies. More intervention studies about how to promote constructive coping are crucial.

Moreover, the evaluation of the studies included in this paper leads us to underline the importance of identifying the different risk factors of eco-anxiety in different populations. There is a need for nationally representative samples in different parts of the world in future studies.

There is a need for epidemiological studies with prospective designs and robust methodology representing the global population, including vulnerable groups such as children and young people, rural, and indigenous populations, to identify causal factors, and moderating and mediating factors, population level health impacts, population responses and development of public policies.

Footnotes

CC= Climate Change; CCA= Climate Change Anxiety; PRISMA= Preferred Reporting Items for Systematic Review and Meta-analyses; MDD = Major Depressive Disorder.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Consent gained from all authors for publication.

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Authors' contribution

Inmaculada Boluda-Verdú and María Pastor-Valero conceived the study. Inmaculada Boluda-Verdú, Mariola Casas-Escolano and Marina Senent-Valero performed the collection and assembly of data. All authors performed the analysis and interpretation. Inmaculada Boluda-Verdú drafted the first manuscript. All authors provided intellectual contributions to the manuscript and critical revision. All authors approved the final version.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A-C. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvp.2022.101904>.

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